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21 Torrington Square  
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Dear Dr. Franklin:

The enclosed drawings and photograph are from my thesis on the structure of TMV. As soon as I can get the text reproduced I'll send you a copy, but since the figures are essentially self-explanatory and are already reproduced, I'm sending them now. The Fig. numbers refer to the text of the thesis. Briefly, the figures are as follows:

Fig 3: Equatorial intensities for two samples of normal TMV recorded using slits of different height (longer slit for bottom curve). This is the same as the data I sent you last fall, with the experimental details as to the recording.

Fig 4: Lead substituted TMV recorded under the same conditions as for fig 3

Fig 8: Correction for the effect of interparticle interference on the central maximum by normalizing the diffraction pattern of a uniform density cylinder to the experimental points. The radius of the uniform density rod is chosen so that the first null point of the experimental and theoretical diffraction pattern coincide.  
Normal TMV at a concentration of 24%

Fig 10: Lead substituted TMV at a concentration of 20%

Fig 11:  $kF(k)$  for normal TMV,  $k = \frac{4\pi}{\lambda} \sin \theta$ . Experimental points for three samples at different concentrations, normalized to the same scale. The solid curve shows  $kF(k)$  for the uniform density cylinder, normalized at the central maximum, as in fig 8. The broken curve gives the position, sign and approximate magnitude for the four intensity maxima beyond the point where reliable Geiger counter measurements were obtained. The intensities were estimated from photographs of the diffraction pattern.

Fig 12  $kF(k)$  for lead substituted TMV. Experimental points for two samples with the same Pb:TMV ratio ( $\approx 2$  lead atoms per crystallographic sub-unit). The broken curve is from the points of fig 11 for normal TMV, and

has been normalized to the data for the lead substituted TMV at the central maximum. Differences in  $kF(k)$  between the normal and lead substituted TMV are indicated by the short bars. The difference transform indicates that equal amounts of lead bind at radii of 25 and 84 Å, and the solid curve is the calculated differences in  $kF(k)$ , on the assumption that all the added lead is bound, and that equal amounts go on at these two radii. That is  $\Delta kF(k)_{pb} = .025 k \{ F(0)_{TMV} [\frac{1}{2} J_0(kR_1) + \frac{1}{2} J_0(kR_2)] - F(k)_{TMV} \}$

Fig 13: Transform of data in Fig 11, to indicate how the various parts of the diffraction pattern contribute to the calculated radial density map. Two sets of integrations were carried out using different intervals in  $k$ . For the smaller interval the estimated errors in  $kF(k)$ , for the region covered by the Geiger counter measurements, were included in the calculations, and the resulting uncertainty in  $P(R)$  is indicated by the error bars.

Fig 14 (which I have already sent you) Resultant radial density projection by addition of the curves in fig 13.

Fig 6: Photograph of the diffraction pattern of a 20% solution of the lead substituted TMV

It appears very likely that the 2 sulfhydryl groups of the crystallographic sub-unit are involved in the binding of lead. If the two parts of the sub-unit are related by a diad, as you suggest, the two cysteine residues should occur at the same radius, and one lead atom might be bound as -S-PL-S-. The iodinated TMV that Fraenkel-Conrat is sending you should establish the location of the sulfhydryl groups, since it appears that the iodine is only on the sulfhydryls. From the results with lead it is probable that the two iodine atoms bound to each sub-unit are either both at 25 Å or 84 Å, or one each at these two radii. It should be possible to distinguish between these three possibilities with photographic measurements, but if there is any uncertainty as to the location of the iodine, I would be happy to undertake Geiger counter measurements on the iodinated TMV. If you would like, I could send

you some of my lead substituted TMV, and some of the normal TMV from which it was prepared.

I will have my results written up for publication soon, and will send you the manuscript when it is ready. A copy of my thesis should reach you before this, and I would very much appreciate your comments on it.

My plan to go to England the end of this summer is fairly definite now, and I'm looking forward to hearing from you about the possibility of working with you for a few months.

If you have prints of your published TMV diffraction pattern, could you send me one, and also a reprint of your recent paper in Acta Cryst. on the structure of DNA.

Sincerely yours,  
Donald Casper